Study of Interfacial Effects Between CARC Polymer Coatings and Various Intermetallic Compounds Known To Exist in AA2024-T3

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Chemical Agent Resistant Coatings (CARC) are multi-layer polymer coatings employed by all branches of the military and used to protect military vehicles from certain forms of chemical attack. They serve another equally vital function as weathering protection for the underlying vehicle. When weathering damages these coatings they undergo changes which can compromise both their protective powers as well as their camouflage capabilities. This weathering is thought to be the result of the combined effects of UV-induced photo-oxidative damage as well as an increase in ionic and moisture transport throughout the coating [1]. In the worst cases the coatings will fail by a combination of flaking, chipping and debonding occurring at the primer-pretreatment interface. Many of these coatings are applied to AA2024-T3, which is known to contain a series of complex Intermetallic Compounds (IMC) of composition Al_2Cu, Al_2CuMg, Al_2CuFe, Al_7Cu_2Fe, $Al_{12}Si(FeMn)_3$, $Al_{20}Cu_2(MnFe)_3$, $Al_{20}Cu_3Mn_3$ [2].

The goal of this research is to study the effect of different IMCs on the debonding/delamination behavior of CARC coatings. Thin films of IMC analogs were deposited on Si by femtosecond laser ablation. The high-sensitivity technique of Laser Speckle Digital Image Correlation was applied to the study of the surfaces of these CARC coatings in an attempt to register changes *at the surface* that occur at the primer-pretreatment interface as a result of weathering and which may possibly indicate the initiation of delamination failures [3]. Electrochemical Impedance was employed to relate the surface changes detected by the aforementioned technique to breakdown at the interface. These results were related to the IMC/matrix type in an attempt to discern the relationship between IMC composition and CARC delamination.

Acknowledgement

This work is supported by the Army research Laboratory, Weapons and Materials Directorate under a SERDP on degradation mechanisms of military paint coatings.

References

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